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[54] **ANCHORED HARDENED CUTTER INSERTS**
6 Claims, 5 Drawing Figs.

[52] **U.S. Cl.**..... **175/374,**
175/410, 76/108

[51] **Int. Cl.**..... **E21b 9/36,**
E21c 13/01

[50] **Field of Search**..... **175/374,**
410; 76/108 R, 108 A

FIG. 1.

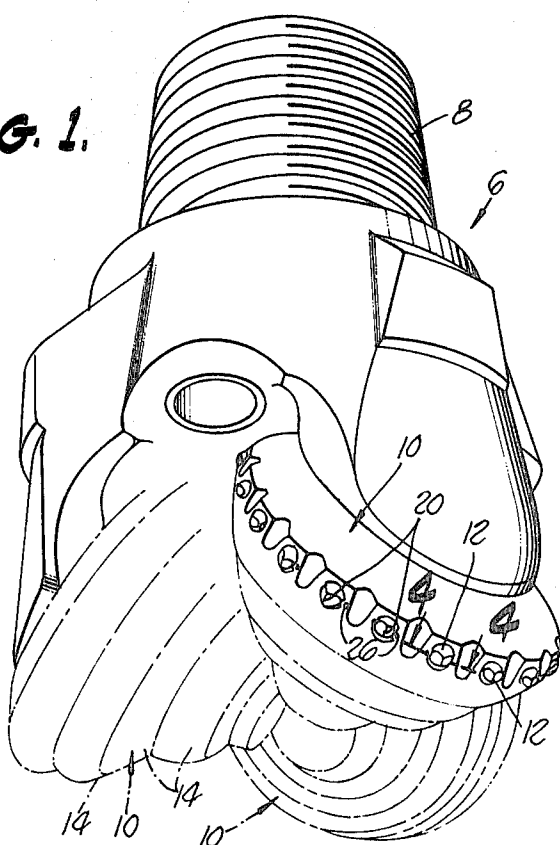


FIG. 5.

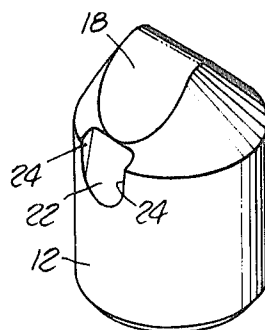
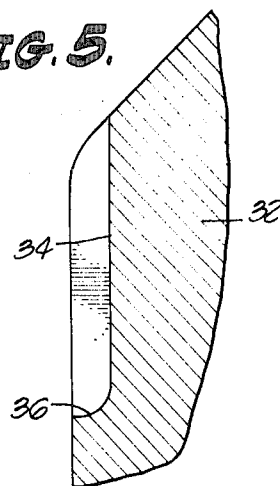


FIG. 2.

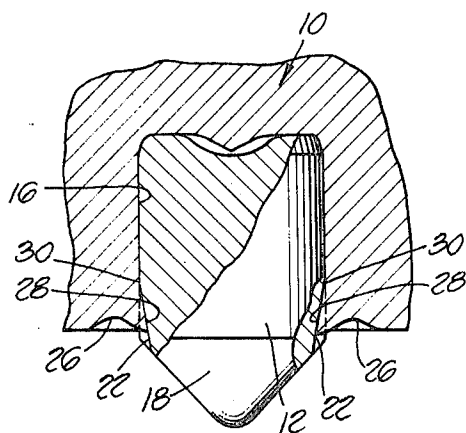


FIG. 4.

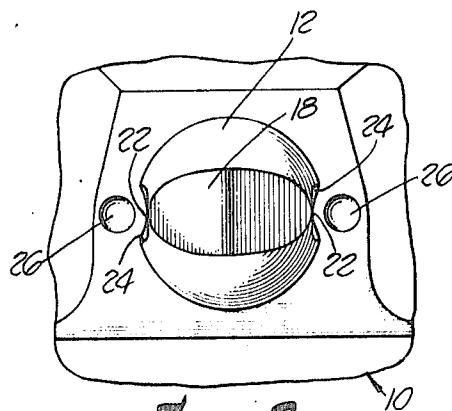


FIG. 3.

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ANCHORED HARDENED CUTTER INSERTS

Rock drilling and boring cutters with hardened metal inserts are used extensively in drilling oil wells and boring tunnels. The metal of the cutter bodies is relatively hard and abrasion resistant but the cutters are subject to high pressures in environments which are extremely abrasive and shock producing. In order to lengthen the lives of such cutters and boring tools, it is customary to provide them with inserts of hardened metal, such as tungsten carbide, which is much harder than the body of the tool but which is too hard to utilize in the fabrication of the cutters as a whole. These inserts frequently have outer or working ends which are of various shapes and, to produce the best cutting action, the working ends must be indexed to a particular position of rotation relative to the rotation of the cutter and its path of cut.

The most commonly used method of securing hardened metal inserts in cutters of the type described is to provide cylindrical sockets in the cutters, to mold sintered tungsten carbide inserts to approximately a cylindrical shape, and after centerless grinding to a substantially true cylindrical shape, to press fit the inserts in the sockets in the cutter body.

Even though inserts which are press fitted into the cutters are rather firmly held therein, the rugged environment in which the tools work is such that the inserts are sometimes tilted out of the cutter bodies with such force that the sockets in which they were anchored are greatly distorted and enlarged. This is due generally to the fact that the insert is first subjected to such great lateral force that the socket in the tool body is enlarged and the insert projects outwardly a greater distance than intended, and thereupon becomes tilted over by a rock formation and is completely extracted from the cutter. In many instances the shape of the exposed working end in the insert is such that when the insert is loosened slightly in its socket, it will turn to a less efficient cutting position, and by reason of its improper positioning, will not only fail to cut properly, but will soon loosen in the socket and become dislodged.

It is an object of the present invention to provide means for anchoring hardened metal inserts in the cutter bodies and a method of preparing and anchoring them so that they will remain much more securely positioned in the cutter and the life of the cutting tool greatly lengthened.

Another object of the invention is to provide a method and an insert anchoring means which includes the forming on the hardened insert before centerless grinding of abutment means which is so positioned relative to the end of the insert and the material of the cutter in which it is anchored, that the cutter material can be staked to deform a portion thereof generally radially inwardly against the abutment to both prevent axial displacement and rotational out-of-index movement of the insert.

The above and other objects will more fully appear from the following description in connection with the accompanying drawing:

FIG. 1 is a perspective view showing a rock drilling tool with the cutter thereof shown partially in broken lines;

FIG. 2 is an enlarged perspective view of one of the hardened metal inserts;

FIG. 3 is a fragmentary detail in elevation of one of the inserts anchored in position;

FIG. 4 is an enlarged sectional detail taken approximately on the line 4-4 of FIG. 1; and

FIG. 5 is an enlarged sectional detail of a modified embodiment.

In the drawing there is shown a drilling tool 6 having a threaded upper end 8 adapted to be secured in a conventional drill collar on a drill string. The tool 6, as is well known in the art, rotatably supports a plurality of cutters 10 which are provided with several circular rows of space hardened inserts 12, only one of the circular rows of inserts being illustrated in the drawing. Others may be located on the several steps 14 of the

cutters. These inserts are conventionally press fitted into sockets 16 which drilled into the cutters 10.

The inserts 12 are conventionally formed of sintered tungsten carbide which is molded to the generally cylindrical side wall shape illustrated, and also to provide the working end configuration indicated at 18. This end configuration may be as illustrated, it may be pyramidal, or one of several other shapes which are utilized in the drilling industry. In FIG. 1 the peaks of the working end of the insert are indicated by lines 20 and are shown lying generally normal to the path of rotation of the rotary cutters 10.

The inserts 12 are shown with abutment means in the form of flats 22, which as shown in FIGS. 2 and 4, extend generally longitudinally of the inserts and are angled inwardly and forwardly slightly. Furthermore, the abutment means 22 on each insert includes a pair of sidewalls 24 which face oppositely to each other in directions generally circumferentially of the insert.

It has been found that a relatively shallow abutment surface 22 with a small angle to the longitudinal axis of the insert can be centerless ground without undue trouble and expense, but if the abutment surface is too deep, grinding will produce an unwanted large flat rather than my controlled abutment.

After the inserts are formed they are press fitted into the sockets 16 in the cutters 10 with the inserts rotationally indexed to the desired position relative to the rotational paths of the cutters. Then the material of the cutter body is staked as shown at 26 to provide metal displacement 28 generally radially inwardly against the abutments 22 and their sidewalls 24. While this amount of staking alone would not provide sufficient anchoring for the inserts, it has been found that they are extremely well anchored where the insert is press fitted and the staking is then done. Not only is the metal of the cutter body displaced as at 28, but it even more firmly presses the metal of the body against the cylindrical sidewall of the insert at the points 30.

By reason of the slight slant of the abutment surfaces 22, the inserts are wedged in their sockets 16 against axial displacement. Furthermore, the staking 26 causes metal to be displaced into contact with the sidewalls 24 of the abutment means so that the inserts will not rotate as they perform their cutting function.

In FIG. 5 there is shown a modified construction in which an insert 32 is provided with a wide shallow groove 34 which may be of uniform depth from end to end as distinguished from the slanted flattened portions 22 of the first embodiment. The inner end of the depressed or flattened portion 34 terminates in an abutment 36. In this form of the invention it may be possible to displace more of the metal of the rotary cutter body into the abutment area of the insert in the staking operation. However, the abutment indentation should not be so great that it will interfere with centerless grinding after molding and sintering in the production of the insert.

Actual trials have been made in the field in drilling for oil and the cutters provided with some inserts customarily press fitted, and others formed and anchored in accordance with my invention. These tests have shown that a startling reduction in the number of displaced inserts occurs and the life of the drilling tool is greatly increased.

Sintered tungsten carbide inserts shrink approximately 18 to 25 percent during sintering and size control is not sufficient for press fitting without centerless grinding. Such operations as knurling or similarly roughened elements on the hardened metal inserts of drilling tools, even if they were practical from an economic standpoint, could not be used because such knurling or roughening cannot be molded into the sidewall after centerless grinding because the molding must take place before the final finishing to the required precise size. Consequently, it is the provision of my abutment means and staking, followed by centerless grinding or a centerless ground product, which renders my hardened metal inserts and their anchoring successful in lengthening the life of tools used in an extremely rugged environment.

It will of course be understood that various changes can be made in the form, details, arrangement and projections of the various parts without departing from the spirit of the invention.

I claim:

1. A drilling tool having rotary cutters thereon, the cutters having cylindrical sockets therein for hardened cylindrical inserts, wherein the improvements comprises: generally cylindrical molded metal inserts, each having a working end and a base end and being of a material whose hardness is such that machining of the inserts is impractical, each insert having on at least one sidewall portion thereof abutment means directed more toward said working end than toward the base end, said inserts being located in the sockets in said cutters with said abutment means laterally adjacent a portion of the material of the cutter in which the insert is mounted, said portions of the material of the cutters being stacked against said abutment means to retain the inserts in the cutter sockets, and said abutment means also being so disposed that some of the staked material of the cutters will lie in the path of rotation of the inserts.

2. The structure in claim 1, and the working ends of at least some of the inserts having cross-sectional conformations defining other than surfaces of revolution and being rotationally disposed in predetermined positions relative to the

rotational paths of said cutters.

3. The structure in claim 1, and said abutment means including portions disposed to oppose rotation of the inserts in opposite directions.

4. The structure in claim 1, and said abutment means being defined by portions of the sides of said inserts which are relieved from their cylindrical shape inwardly from the working ends of the inserts.

5. The structure in claim 4, and said relieved portions of said inserts being flatted.

6. The method of producing and anchoring hardened metal inserts in rotary drilling cutters which includes: molding sintered metal inserts of generally cylindrical cross section with outer working ends, and in the molding operation forming on the inserts within the confines of their otherwise cylindrical cross section and inwardly from their outer working ends non-cylindrical abutment surfaces having portions of their greater radial depth adjacent the outer working ends of the inserts than portions more axially inward therefrom, centerless grinding the inserts to substantially true cylindrical cross section, forming cylindrical sockets in the cutters, press fitting the inserts in the cutter sockets, and staking the metal of the cutter adjacent said cutter sockets and their received inserts to displace metal of the socket walls inwardly against the noncylindrical abutment surfaces of the inserts.

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